SHORTER ARTICLES.

CRYSTALS OF OXALATE OF LIME IN PLANTS.

Agricultural and physiological chemists are generally of the opinion that one of the functions of lime in the nutrition of plants is to form an insoluble compound with oxalic acid and thus neutralize any toxic effect which this acid might have upon the plant tissues. Whether this theory is true or not it is quite certain that crystals of calcium oxalate are found in many plant tissues, while in some, especially those developing large quantities of organic acids, they are very abundant. A remarkable occurrence of such crystals has lately been disclosed by an investigation carried on in this bureau by Mr. B. J. Howard, chemical microscopist and histologist, on a sample of *Colocasia antiquorum,* the well-known taro, one of the principal food staples of Polynesia, brought to the bureau by Mr. W. E. Safford, assistant curator of the Bureau of Plant Industry, who is preparing a report on the economic plants of Polynesia. Mr. Safford stated that the intense burning and pricking sensation which is experienced on chewing parts of certain plants, such as the Indian turnip (*Arisæma triphyllum*) and the plant above mentioned, has been alleged to be due to the action of the acicular crystals of calcium oxalate which are said to exist in immense numbers, and which attach themselves to and enter, at least superficially, the mucous and other membranes with which they come in contact. I requested Mr. Howard to make a micro-chemical examination of this sample in order to determine whether or not such crystals were present. A simple trituration of the parts of the plant, as, for instance, a leaf, in water until a pulp is produced, is a sufficient preparation. A small portion of the pulp is placed upon a glass slide, a drop of water added (or water and glycerine) covered with a glass, and placed in the field of the microscope. When thus prepared, numerous very oblate spheroidal bodies were discovered within which were enclosed fine needles in a dense bundle. Some of these acicular and very long delicate crystals were dissolved in hydrochloric acid and were found to produce a precipitate of oxalate of lime when made alkaline by ammonia. The crystals of oxalate of lime produced in this way were not acicular as in the original case, but tetrahedral. While examining the field of the microscope, Mr. Howard observed in the case of one of the oblate spheroids the projection of these crystals into the ambient liquid with what seemed to be a considerable degree of force. This observation was so interesting that I requested Mr. Howard to prepare another portion of the material and see if the phenomenon be repeated. I first examined carefully the field of the microscope as prepared, but found no crystals, but a large number of spheroids above mentioned in which the bundles of long acicular crystals could be easily distinguished. These were surrounded by a membrane of quite uniform thickness, apparently of a cellular nature and probably consisting mostly of a cellulose—in other words, the crystals seemed to be encysted. During a period of observation of from five to ten minutes I did not notice the recurrence of the phenomena above described. Mr. Howard then observed the field in the microscope, and in a few minutes he said that one of the bombs had begun to discharge its projectiles. I immediately took Mr. Howard's place at the microscope and saw, for a period of five or ten minutes, a most remarkable display. Continual discharges were made from this bomb, the ends of the arrows spreading out as they emerged in groups of from four to ten. As these groups were finally separated from the bombs, they were discharged with considerable velocity into the ambient liquid, the bomb itself suffering a corresponding recoil. I did not keep an accurate account of the discharges made; but I would say that they would average not less than two per minute. Sometimes one or two needles only would be discharged, projecting rapidly, and then leaving the bomb finally with a sharp advance. At other times, as before mentioned, groups of from four to ten arrows would discharge at once. The field of vision in the vicinity of the bomb became partly covered with these long crystals, but the supply within the bomb did not seem to diminish materially. There

must have been many hundreds of these arrows in one single spheroid. Perhaps an oblate spheroid is not the best description of one of these masses. They resemble more a long capsule used in pharmacy with rather sharper ends, or the cigar-shaped balloon of an airship.

In looking for the cause of the discharge I suggested to Mr. Howard that it might be due to the contraction of the cell walls, due either to pressure of the cover glass or to drying. Mr. Howard suggested, and it is a very plausible reason, that it might be osmotic pressure due to the presence of certain mineral substances in the mother liquor. He proposes to test this theory experimentally by making a salt solution for mounting, to imitate, if possible, that within the bomb and thus to exclude osmotic pressure. Presumably, when left in the tissues of the plant the crystals are not discharged; at least, in the preparation which was under observation no free crystals were found until the bomb began to discharge the missiles; as the plant would grow older, however, and the osmotic conditions change, or the cell walls begin to dry, the discharges would begin to take place in the tissues of the plant. These bombs are bundles of crystals and are, of course, exceedingly small, and most of them would doubtless escape rupture during mastication, but a sufficient amount of them would discharge their arrows to account for the pricking sensations attending the mastication of this material.

Mr. Safford, who, while connected with the navy, spent some time among the Polynesians and made a study of the foods in common use, says that this plant is one of the principal food staples of the Polynesians and other Pacific islanders, who eat both the starchy rootstock, either baked or made into paste, and the young leaves which taste not unlike asparagus.

If the plant is not thoroughly cooked its acrid qualities remain in some degree. If thoroughly cooked they are destroyed. It is interesting to note that in cases where the leaves are chewed, either fresh or dried, the stinging sensation is not perceived until a few moments afterward, and in many cases it is not until the taro root has been eaten that the prickling sensation in the lining of the mouth and throat shows that it has not been thoroughly cooked.

Alocasia indica, a plant closely allied to the taro plant, is so acrid that the Pacific islanders resort to it only in cases of great scarcity of food. The disagreeable effects caused by these plants seem to be confined to the temporary prickling sensation of the mouth and throat. They are undoubtedly nutritious and are held in high esteem by the natives. The acrid principle in the manioc or cassava is at least partly due to the presence of hydrocyanic acid, and this is removed by cooking. It will be interesting to see if any of this poisonous acid is also found in the taro and *Alocasia indica.*

In the case of an Indian turnip lately examined by Mr. Howard, the capsules were found to be somewhat smaller and the crystals larger and shorter than those described. A drop of the sap of the taro, which was shown under the microscope to contain no crystals, did not produce a burning sensation when placed in the mouth. On the contrary, a drop of the juice of the Indian turnip which carried free crystals was quite active in producing the characteristic symptoms. These facts are additional evidence to support the theory at first mentioned.

While not yet fully established, there is presumptive evidence that the pricking and burning sensation experienced in masticating materials of this kind is mostly of mechanical origin.

H. W. Wiley.

THE SEMINAR METHOD IN NATURAL SCIENCES, ESPECIALLY IN ZOOLOGY.

Any one who has watched, for a number of years, the announcements of the lectures at German universities, will have noticed that the so-called 'Seminar-Ubungen,' 'Colloquia,' or 'Besprechungen,' and 'Wissenschaftlichen Gesellschaften' have been extended more and more, and now take often an important place among the courses offered by a department.

The desire of reaching the student better